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Research Article

Design and Construction of a Blood Type Detection Device with a Color Sensor Based on Arduino Uno

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Abstract: A Blood Type Detector is an electronic device used to detect human blood types. Blood type detection and observation are generally carried out through a series of experiments on blood samples, namely antiserum reactions (anti-A, B, AB, and D). Currently, determining a person's blood type is still done manually. This will certainly be complicated and require extra attention if the blood sample to be tested is quite large in number, it will take a lot of time and is inefficient. The purpose of research on a Blood Type Detector Tool with an Arduino Uno-Based Color Sensor is to improve the efficiency, accessibility, and quality of health care as a whole. As well as ease of access and data processing for users. This tool is designed using a Color Sensor so that it can detect the occurrence of agglutination or non-agglutination reactions from blood samples that have been mixed with antigens. The working system settings of this tool are based on Arduino Uno, the results of which will be displayed on the LCD, then a sound will appear from the results of the blood type being read. In the blood type test function test process, a blood sample and antigen are required, where the blood sample and antigen are mixed together, the ratio is one drop of blood with one drop of antisera, then stirred together, so that agglutination or non-agglutination occurs in the blood sample that has been mixed with the antigen. After sampling, the blood type tester will detect the four blood samples dropped onto the sample card. When the blood sample in anti-A and AB coagulates, the sensor will read a value of >200 for blood type A.

Keywords: Arduino Uno, Blood, DWIN LCD Reagent, Speaker, TCS3200 Sensor.

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1. Introduction

A blood type detector is an electronic device used to test human blood types. Testing and observation to determine blood types are generally carried out with a series of experiments on blood samples, namely carrying out a reaction between antisera fluid (anti A and B) with the blood sample to be tested on a glass object. The physical changes that occur from this reaction are agglutination or non-agglutination and the combination of the resulting reactions will determine a particular blood type. (Sinta Jufri, 2018)

Blood is a fluid in the human circulatory system that plays a vital role in human life (Oktari, 2016). Blood consists of plasma and blood cells, and plasma and blood cells are the body's transport medium. The primary function of human tissue is to carry oxygen and nutrients. The demand for blood supplies in hospitals to support blood transfusions and operations continues to increase, so blood donors are urgently needed. The patient's blood

type must match the donor's blood type, otherwise an allergic reaction may occur. In the ABO blood grouping system, blood is divided into four groups: A, B, O, and AB (Muchlas, 2007).

A blood type detector is a device used to detect human blood type. Blood type detection and observation are generally conducted through a series of experiments on blood samples, namely antiserum reactions (anti-A, B, and AB) and testing on glass slides. Currently, blood type determination is still done manually.

A blood type detector is an electronic device used to test human blood types. Testing and observation to determine blood types are generally carried out with a series of experiments on blood samples, namely carrying out a reaction between antisera fluid (anti-A and B) with the blood sample to be tested on a glass object. The physical changes that occur from this reaction are agglutination or non-agglutination and the combination of the resulting reactions will determine a particular blood type (Jufri, 2018). Blood is a fluid in the human circulatory system that plays a vital role in human life. Blood consists of plasma and blood cells, and both are the body's transport medium. The primary function of human tissue is to carry oxygen and nutrients. The demand for blood supplies in hospitals to support blood transfusions and operations continues to increase, so blood donors are urgently needed. The patient's blood type must match the donor's blood type, otherwise an allergic reaction may occur. In the ABO blood grouping system, blood is divided into four groups: A, B, O, and AB (Muchlas, 2007; Oktari, 2016). A blood type detector is a device used to detect human blood type. Blood type detection and observation are generally conducted through a series of experiments on blood samples, namely antiserum reactions (anti-A, B, and AB) and testing on glass slides. Currently, blood type determination is still done manually.

This is certainly very complicated and requires extra attention if the blood sample being tested is large, which would be time-consuming and inefficient. Furthermore, the human eye relies on visual acuity to assess blood clotting and mixing results. The eye also has limitations affected by fatigue, making this testing method highly risky (Candra Wijaya, 2022).

2. Literature Review

Research related to blood type detection devices has been conducted previously by several researchers, the first referring to the Final Project of a Student of the Semarang Electrical Engineering Academy, M. Safi'I (2021) with the title "DESIGN AND CONSTRUCTION OF AN ARDUINO UNO-BASED ABO BLOOD TYPE TEST DEVICE". The device uses a light source from an LED to illuminate the sample area to be captured by the LDR as a detector. The output in the form of resistance is processed by the processor and displayed on an LCD display.

The 89S51 Microcontroller-Based Human Blood Type Detection Device, designed by Izzah Fadhilah Akmaliah and Naniek Andiani, from the Faculty of Engineering, Pancasila University, Jakarta, was built using the ABO method as a blood type determination system. The device was designed by adding a simple stirrer. However, the device is still relatively complex, because there are still many circuits that must be built, such as a comparator circuit, motor driver, signal conditioner, and others. The success rate is 87%.

AT89S52 by Muchlas, Tole Sutikno, and Santiko, from the Faculty of TechnologyAhmad Dahlan University's industry. Built using a centrifuge system, which requires eight blood samples before being used to determine blood type, and equipped with a simple automatic stirrer. However, the display still uses a seven-segment display. The success rate is 60%..

Figure 1. Blood Type Detector With Color Sensor

Supporting Technology Components

a. DWIN TFT LCD

b. TCS3200 Color Sensor

c. Stepper Motor

d. MP1584EN Module

e. MRB045 Module

f. On/Off Switch

g. Speaker

3. Method

Based on the results of the research methodology that has been carried out, it is known that the TCS3200 color sensor has the ability to detect color intensity based on changes in the output frequency produced by photodiodes with red, green, blue, and transparent filters. However, until now there has been no research that specifically develops a blood type detection system based on this color sensor technology. In fact, the blood type

identification process generally still uses conventional methods based on manual agglutination reactions that require technical expertise from laboratory personnel and relatively longer testing times. By seeing this opportunity, the author intends to design and build an automatic blood type detection tool, using a TCS3200 color sensor integrated with a microcontroller. This system is designed to detect color changes that occur due to blood reactions with blood type reagents (anti-A, anti-B, and anti-D), which are then processed and interpreted by software to determine a person's blood type results. This innovation is expected to be an initial solution in developing diagnostic tools.

System Design

The block diagram serves to make it easier for someone to understand how the tool itself works. Figure 2 shows a block diagram of the design stage of all components used in the process of making the Design of a Blood Type Detector Tool with a Color Sensor Based on Arduino Uno. When the tool is turned on, start by pressing the power button to turn on the tool then press the button to eject the gold card holder, then insert the card that has been given a blood sample and a drop of reagent and press start on the LCD display. Arduino will command the sensor to read samples from 4 blood samples driven by a Stepper Motor. Then the results will be displayed on the LCD and the SPEAKER will tell you the results.

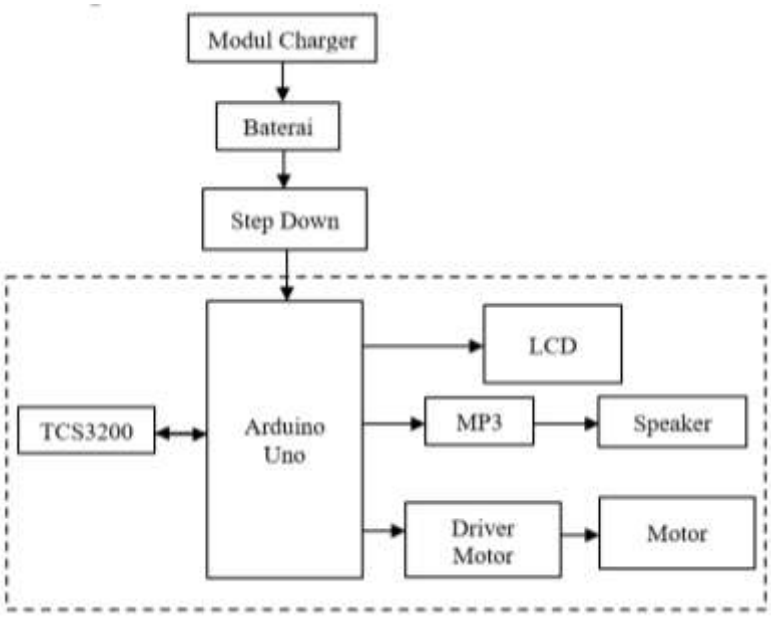

Figure 2. Block diagram

Program Algorithm (Flowchart)

A flowchart is a diagram with graphic symbols that shows the flow of an algorithm or process, displaying steps symbolized in the form of boxes and their sequence, by connecting each step with an arrow. To understand the working principle of the Arduino Uno-based blood type detection device with a color sensor.

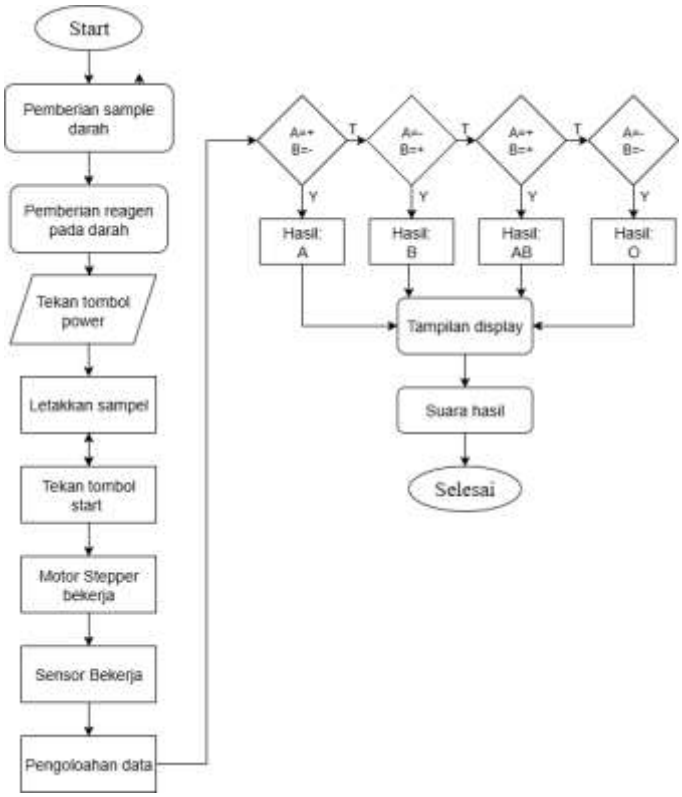

Figure 3. Flowchart of programming flow

Overall Circuit and Tool Design

All components are assembled in a single, closed system using a heat-resistant metal frame. The control buttons, LCD, and heater are ergonomically positioned.

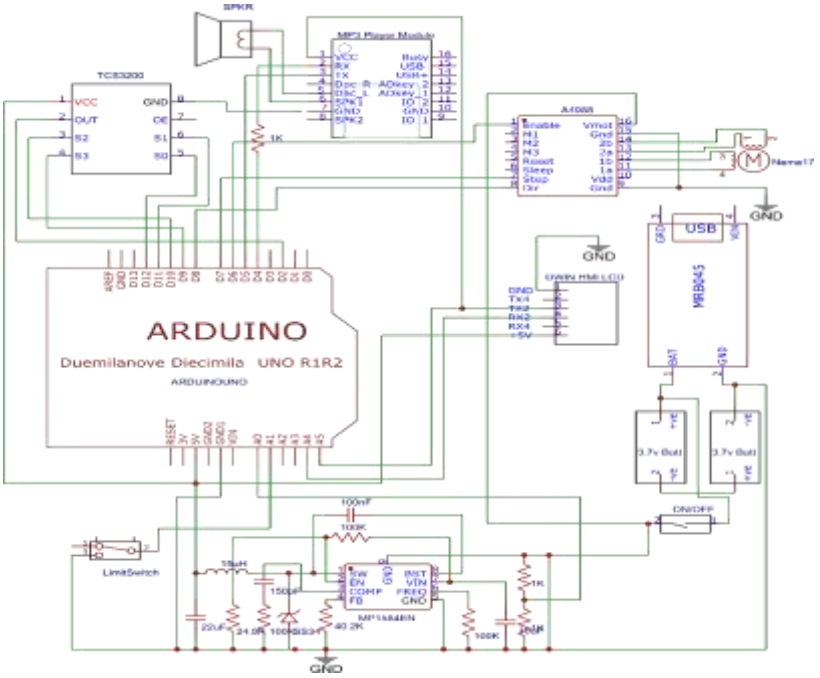

Figure 4. Overall circuit

4. Results and Discussion

Based on the data from the measurements at the predetermined points, they will then be compared with existing theory to determine whether there are any deviations from the theoretical results. The data used for the analysis is taken from the comparison values of the results of previous repeated tests. The comparison value between agglutinated (clumping) and non-agglutinated (non-clumping) samples is approximately 25.

Table 1. Blood Sample A Measurement Result Value

Point Measurement	Theory	Practice	Note
Anti A	**> 200**	**200-250**	**Good**
Anti B	**< 200**	**0-200**	**Good**
Anti-AB	**> 200**	**200-250**	**Good**
Anti D	**Rh+(> 200) or Rh-(< 200)**	**Rh (+) 200-250 Rh (-) 0-200**	**Rh(+/-)**

From the results of the function test conducted by the author, on each blood sample. In the anti-A sample, the blood sample was given anti-A reagent, the result was agglutination (clotting). In the anti-B sample, the anti-B reagent was given, the result was no clotting. In the anti-AB sample, the blood sample was given anti-AB reagent, the result was non-agglutination (not clotting). In the anti-D sample, the anti-D reagent was given, the result was if it clotted, the result was Rh(+) if it did not clot, the result was Rh(-). From the results of these data, it can be seen that the blood sample is type A blood type.

Table 2.Blood Sample B Measurement Result Value

Point Measurement	Theory	Practice	Note
Anti A	**< 200**	**0-200**	**Good**
Anti B	**> 200**	**200-250**	**Good**
Anti-AB	**> 200**	**200-250**	**Good**
Anti D	**Rh+(> 200) or Rh-(< 200)**	**Rh (+) 200-250 Rh (-) 0-200**	**Rh(+/-)**

From the results of the function test conducted by the author, on each blood sample. In the anti-A sample, the blood sample was given anti-A reagent, the result was non-agglutination (not clumping). In the anti-B sample, the anti-B reagent was given the result was agglutination (clumping). In the anti-AB sample, the blood sample was given anti-AB reagent, the result was non-agglutination (not clumping). In the anti-D sample, the anti-D reagent was given the result if it clumped, the result was Rh(+) if it did not clump, the result

was Rh(-). From the results of these data, it can be seen that the blood sample is type B blood type.

Table 3. AB Blood Sample Measurement Results Value

Point Measurement	Theory	Practice	Note
Anti A	> 200	200-250	Good
Anti B	> 200	200-250	Good
Anti-AB	> 200	200-250	Good
Anti D	Rh+(> 200) or Rh-(< 200)	Rh (+) 200-250 Rh (-) 0-200	Rh(+/-)

From the results of the function test conducted by the author, on each blood sample. In the anti-A sample, the blood sample was given anti-A reagent, the result was agglutination (clotting). In the anti-B sample, the anti-B reagent was given the result was agglutination (clotting). In the anti-AB sample, the blood sample was given anti-AB reagent, the result was agglutination (clotting). In the anti-D sample, the anti-D reagent was given the result if it clotted, the result was Rh(+) if it did not clot, the result was Rh(-). From the results of the data, it can be seen that the blood sample is of type AB blood type.

Table 4. Blood Sample Measurement Results Value O

Point Measurement	Theory	Practice	Note
Anti A	< 200	0-200	Good
Anti B	< 200	0-200	Good
Anti-AB	< 200	0-200	Good
Anti D	Rh+(> 200) or Rh-(< 200)	Rh (+) 200-250 Rh (-) 0-200	Rh(+/-)

From the results of the function test conducted by the author, on each blood sample. In the anti-A sample, the blood sample was given anti-A reagent, the result was non-agglutination (did not clot). In the anti-B sample, the anti-B reagent was given the result was non-agglutination (did not clot). In the anti-AB sample, the blood sample was given anti-AB reagent, the result was non-agglutination (did not clot). In the anti-D sample, the anti-D reagent was given the result if it clotted, the result was Rh(+) if it did not clot, the result was Rh(-). From the results of these data, it can be seen that the blood sample is type O blood type.

Tool Function Test Analysis

In conducting the functional test, the tool was used to compare the performance of the design module with several blood types. The test was conducted to determine the value of each blood sample and several blood types in terms of antigen reactions. The following table shows the functional test of the tool, which is shown in Table 5.

Table 5. Test Result Value

No	Name	Anti A	Anti B	Anti-AB	Anti D	Results
1.	Mumun	221	138	227	200	A+
2.	Huda	200	162	214	152	A-
3.	Tejo	145	200	193	210	B+
4.	Zidan	145	208	225	145	B-
5.	Dannu	210	200	227	218	AB+
6.	Salman	200	215	223	212	AB-
7.	Uzzam	154	154	171	171	O-
8.	Hafit	171	145	154	208	O+

Based on the functional test results in Table 5, it can be said that each blood sample given the reagent will produce different reading values. When the blood sample reaction clots, the sensor reads >200, and if the reaction in the sample does not clot, the sensor reads <200. From these results, it can be determined blood types A, B, AB, O, and Rh(-/+).

6. Conclusion

After completing the design of a blood type detection device with an Arduino Uno-based color sensor, starting from field observations, literature studies, planning, experiments, data collection, and data analysis, the following conclusions were drawn.

The author's design and construction of a blood type detection device with an Arduino Uno-based color sensor have been successfully implemented. This device can determine blood types A, B, AB, O, and their Rh levels from the tested samples.

Functional tests carried out on the ABO system blood type test tool can determine the type of blood type by the clotting method (agglutination). When the blood sample in the anti A and AB samples clots and the value reads >200, it indicates the type of blood type A. When the blood sample in the anti B and AB clots, the value reads >200, it indicates the type of blood type B. When the blood sample in the anti A to AB clots, the value reads >200, it indicates the type of blood type AB. And when the blood sample in the A, B, AB sensor does not clot, the value reads <200, it indicates the type of blood type O. For the blood sample in the anti D (rhesus) clots, the value reads >200, it has a positive rhesus (+). When the blood sample in the anti D (rhesus) does not clot, the value reads <200, it has a negative rhesus (-). The results of the check will be displayed on the LCD and the Speaker will make a sound.

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